

material, was isolated in *ca.* 70% yield. Further, the aldehyde VIII was converted smoothly to tigogenin acetate [m.p. 200–202°, $[\alpha]_D -74^\circ$ (CHCl_3)] when it was treated with boron trifluoride etherate in benzene for sixteen hours at room temperature. In blank experiments, *no* tigogenin was produced from dihydrotigogenin monoacetate (VII) by treatment with acidic reagents.

It may be noted that the recent deuterium

exchange experiments of Callow and Massy-Beresford¹ are entirely in accord with the isomerization mechanism here proposed.

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BOOK REVIEWS

The Effects of Ionizing Radiation on Natural and Synthetic High Polymers. By FRANK A. BOVEY, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1958. xiii + 287 pp. 16 × 23.5 cm. Price, \$8.00.

Under the editorship of Professor H. Mark a new series of books on polymers has been started, a series entitled "Polymer Reviews" of which the first is this interesting book written by F. A. Bovey, on radiation effects in polymers. Professor Mark is to be congratulated for initiating this series; we look forward to additional volumes as time goes on.

The first two chapters of Dr. Bovey's book summarize the properties of ionizing radiations and the chemical effects produced by them in gases and condensed systems. The subject matter of these two chapters is well organized and clearly written, but it constitutes in no sense a complete or authoritative discussion of the subject. For example, while radiation sources are briefly described and illustrated by photographs, the reader will find here no helpful details, such as thickness of shielding required or detailed designs of radiation cells. The author is uncertain whether to recommend 20 or 15.5 for $G(\text{Fe}^{+++})$ in the Fricke dosimeter. However, these first two chapters do constitute a good introduction to the subject of radiation chemistry.

Next comes a chapter summarizing the history of ionizing effects in high polymers, crosslinking and scission, effect of oxygen, protection and promotion, and the general effects of ionizing radiations on the physical, chemical and electrical properties of high polymers. In the historical section references to the early American¹ and Soviet² work are missing. The discussion of crosslinking and scission emphasizes such effects, probably because of their importance in influencing properties of industrial interest, while at the same time the production and decay of unsaturation are hardly mentioned. The section on the general effects of oxidation is as good as could have been written considering the incomplete knowledge of the mechanism and kinetics of radiolytic oxidation existing at the time the book was written (and even today, for that matter). In discussing protective action and energy transfer effects, the author correctly describes the important work of Manion and Burton, but Fig. III-I(b) illustrates the independence of effects and no energy transfer in mixed benzene and toluene, rather than any protective action. The fourth chapter describes and simplifies in a well written manner, mathematical theories of gelation, crosslinking, scission, branching and endlinking and various combinations of these effects. This is probably the best chapter of the book and exemplifies the author's own interest in these aspects of the radiation chemistry of polymers.

(1) M. Dole, Report of Symposium IV. "Chemistry and Physics of Radiation Dosimetry," Army Chemical Center, Md., 1950, p. 120.

(2) V. L. Karpov, "Conference of the Academy of Sciences of the U.S.S.R. on the Peaceful Uses of Atomic Energy," July 1, 1955, English Translation U.S. Atomic Energy Commission, Washington, D.C., 1956.

The rest of the book contains chapters in which specific solid polymers are considered one after the other. With a few exceptions, everything that has been discovered through the year 1956 about the action of ionizing radiations on solid polymers is mentioned. Subjects completely omitted are (1) the use of ionizing radiations in promoting the polymerization of monomers, and (2) the production of graft polymers. Perhaps these subjects are reserved for later volumes in the series. The last chapter on natural macromolecules, such as cellulose, proteins, viruses, etc., contains an interesting account of radiation effects in this complex field. Again, it is only an introduction, but a good one, and not an authoritative treatment. For example, the author interprets the results of Fricke on egg albumin as due to "hidden" breaks in the polypeptide chain, for which there is no conclusive evidence.

Surprisingly, the subject of the oxidation of polymers during irradiation has been poorly handled. Thus, the important paper of Sears and Parkinson³ in which post-irradiation oxidation effects were first described is not mentioned. If the author had read the first American work¹ on polyethylene, he would not have concluded that the results of Lawton, Balwit and Powell demonstrate that "carbonyl formation in polyethylene is mainly a postirradiation effect." The significant observations of Chapiro⁴ are quite inadequately described. Admittedly we have much learned, but even in 1956 we knew more than the reader of Dr. Bovey's book would infer.

In his foreword Professor Mark expressed the hope that this volume will be stained by chemicals while left lying on working benches in laboratories rather than remaining clean and neat standing on library shelves. Because of his excellent organization and comprehensive coverage of this extremely active branch of polymer chemistry, it is quite evident that Dr. Bovey's book will fulfill Professor Mark's expectations. Those of us who are working in this field will be indebted to Dr. Bovey for many years for his helpful review.

(3) W. C. Sears and W. W. Parkinson, Jr., *J. Polymer Sci.*, **21**, 325 (1956).

(4) A. Chapiro, *J. chim. phys.*, **52**, 246 (1955).

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The Properties of Gases and Liquids. Their Estimation and Correlation. By ROBERT C. REID, Associate Professor of Chemical Engineering, Massachusetts Institute of Technology, and THOMAS K. SHERWOOD, Professor of Chemical Engineering, Massachusetts Institute of Technology. McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 36, N. Y. 1958. xii + 386 pp. 16 × 23.5 cm. Price, \$10.00.

One of the most important problems facing design engineers is the accurate prediction and extrapolation of physical data. This book is a summary of methods available